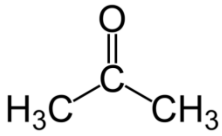
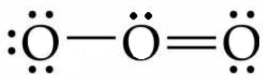
ANSWERS: Crystal ball questions on Explaining Polarity of molecules

Key points to consider for an Excellence grade are...
Does the molecule
1) contain polar bond(s), you must refer to a difference in electronegativity between the relevant atoms
2) contain lone pair(s) around the central atom
3) have a symmetrical shape
4) whether the polar covalent bonds (aka dipoles) cancel

CS_2 **CS_2** has non-polar molecules. The C–S bonds of CS_2 are polar due to the differing electronegativities of C and S atoms. However, as there are only 2 electron repulsions (2 bonding regions and no lone pairs) about the central C atom, the polar bonds are symmetrical about the C atom with a linear shape, and the effect of these polar bonds/bond dipoles is cancelled, so that the molecule is nonpolar.	N_2 **N_2** has non-polar molecules. There is a triple bond between the 2 Nitrogen atoms, bonds between 1 N atom and another N atom are non- polar due to the exact same electronegativities of the 2 Nitrogen atoms. As there is only 1 region of electron repulsions between the 2 N atoms, the triple bond between the 2 N atoms is symmetrical with a linear shape so the molecule is nonpolar. other similar examples are O_2	CH_3OH In **CH_3OH**, the polarity of the C–H bonds and the C–OH bonds are different; due to differences in electronegativity between the C, H and O atoms (the C–O bonds are more polar). There are 4 bonding regions of electron repulsion around the central C atom (with no lone pairs). Because of the higher electronegativity of the O atom, the charges are not spread evenly around the central C atom /the dipoles do not cancel, and the molecule is polar overall.
HCN **HCN** has polar molecules. The C-H and C–N bonds of HCN are polar due to the differing electronegativities of C, H and N atoms. However, as there are only 2 electron repulsions (2 bonding regions and no lone pairs) about the central C atom, the polar bonds are symmetrical about the C atom with a linear shape, and the effect of these polar bonds/bond dipoles is cancelled, so that the molecule is nonpolar.	PCl_3 In **PCl_3**, the P–Cl bonds are polar due to differences in electronegativity /dipoles of P and Cl atoms. The three polar P–Cl bonds are not spread symmetrically around the trigonal pyramid shaped molecule, due to the lone pair of electrons (there are 4 regions of electron density around the central P atom, 3 of these are bonding regions and 1 is a lone pair), therefore the molecule is polar. other similar examples are PH_3 and NBr_3	

CH_3COCH_3  There are 3 regions of electron density (3 bonding regions and no lone pairs) around the central carbon atom which results in a trigonal planar shape. However, there is an electronegativity difference between the carbon and oxygen atoms resulting in an uneven distribution of charge so the molecule is polar	CH_4 In **CH_4**, the C–H bonds are polar, due to differences in electronegativity of C and H atoms. However, four C–H bonds are arranged symmetrically in a tetrahedral shape (with 4 bonding regions and no lone pairs around the central atoms) and the charges are spread evenly, resulting in a non-polar molecule.	C_2H_4 There is an electronegativity difference between the C and H atoms, however the central C atoms have no electronegativity difference between them. The The carbon atoms in C_2H_4 have three bonding regions (an no lone pairs) around them. This results in a trigonal planar shape. Since the molecule is symetrical, there is an even distribution of charge and so the molecule is non-polar
HCl **HCl** has non-polar molecules. There is a single bond between the H and Cl atoms and a difference in electronegativity between the H and Cl atoms. The bond between the H and Cl atoms is non-symmetrical with a linear shape so the molecule is polar.	SF_2 In **SF_2**, the S-F bonds are polar, due to differences in electronegativity of S and F atoms. There are 4 regions of electron repulsion around the central S atom (2 bonding regions and 2 regions of lone pairs). The 2 lone pair of electrons on the S atom causes the SF_2 to occupy a bent or V shape around the central S. Therefore the effect of these polar bonds/bond dipoles is not cancelled, so that the molecule is polar.	O_3  **O_3** has polar molecules. The O−O bonds of O_3 are non-polar due to the exact same electronegativities between the O atoms. There are 3 electron repulsions (2 bonding and 1 lone) about the central O atom (trigonal planar). The lone pair of electrons on the O atom causes the O_3 to occupy a bent or V shape around the central S. Therefore the effect of these polar bonds/bond dipoles is not cancelled, so that the molecule is polar.

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